Claims

What is claimed is:

1. A control system for determining a position of an implement arm having a work implement, the implement arm having mating components connected by at least one joint, comprising:

at least one position sensor operably associated with the implement arm and configured to sense positional aspects of the implement arm;

at least one load sensor operably associated with the implement arm and configured to sense the direction of loads applied to the at least one joint; and

a controller adapted to calculate a position of the implement arm based on signals received from the at least one position sensor and the at least one load sensor, the calculated position taking into account shifting of the implement arm caused by clearances existing at the at least one joint between the mating components of the implement arm.

2. The control system of claim 1, wherein the mating components are connected by a pin connection at the at least one joint and the clearances existing between the mating components include a pin clearance at the pin connection.

3. The control system of claim 2, wherein the mating components of the implement arm include:

a boom;

a stick attached at a stick joint to the boom; and

a work implement attached at a work implement joint to the stick.

4. The control system of claim 1, wherein the controller is adapted to take into account the shifting by determining an angular rotation of the mating components of the implement arm caused by the clearances.

5. The control system of claim 1, wherein the controller is adapted to determine a first calculated position and a second calculated position and determine a movement distance of the implement arm by comparing the first calculated position with the second calculated position.

6. The control system of claim 5, further including a display configured to show the movement distance.

7. The control system of claim 1, wherein the load sensor is a strain gauge associated with a pin at the at least one joint.

8. The control system of claim 7, wherein the load sensor is at least two strain gauges associated with the pin, the two strain gauges being offset by 90 degrees.

9. The control system of claim 8, wherein the controller is adapted to take into account the shifting by determining the direction of shifting based on the signals received from the two strain gauges and adapted to determine an angular rotation of the mating components of the implement arm caused by the clearances.

10. A method for determining a position of an implement arm having a work implement, the implement arm having mating components connected by at least one joint, comprising:

sensing a positional aspect of the implement arm with a position sensor;

sensing a directional aspect of loads applied to the at least one joint with a load sensor; and

calculating a position of the implement arm based on signals received from the position sensor and the load sensor, wherein calculating the position includes taking into account shifting of the implement arm caused by clearances existing at the at least one joint between the mating components of the implement arm.

11. The method of claim 10, wherein the mating components are connected by a pin connection and the clearances existing between the mating components include a pin clearance at the pin connection.

12. The method of claim 10, wherein taking into account the shifting includes determining an angular rotation of the mating components of the implement arm caused by the clearances.

13. The method of claim 10, further including:

determining a first calculated position;

determining a second calculated position; and

determining a movement distance of the implement arm by comparing the first calculated position with the second calculated position.

14. The method of claim 13, further including displaying the movement distance of the implement arm to an operator.

15. The method of claim 14, further including displaying the movement distance of the implement arm in real-time.

16. The method of claim 13, further including determining the movement distance on board ~~the~~ a work machine.

17. The method of claim 10, wherein the load sensor is a strain gauge associated with a pin at the at least one joint.

18. The method of claim 17, wherein the load sensor is at least two strain gauges associated with the pin, the two strain gauges being offset by 90 degrees.

19. The method of claim 18, wherein taking into account shifting includes:

determining the direction of shifting based on the signals received from the two strain gauges; and

determining an angular rotation of the mating components of the implement arm caused by the clearances.

20. A method for determining a position of an implement arm having a work implement, the implement arm having mating components connected at joints, comprising:

sensing a positional aspect of the implement arm with a position sensor;

sensing a directional aspect of loads applied to the joints with a load sensor;

determining an angular rotation of the mating components of the implement arm due to shifting at the joints caused by clearances between the mating components of the implement arm;

calculating a first position of the implement arm based on signals received from the position sensor and the load sensor, wherein calculating the first position includes taking into account the shifting at the joints between the mating components;

storing the calculated ~~position as a~~ first position;

calculating a second position of the implement arm, wherein calculating the second position includes taking into account the shifting at the joints between the mating components;

obtaining a movement distance of the implement arm by comparing the first position of the implement arm with the second position of the implement arm; and

displaying the movement distance to an operator in real-time.